Tennessee Base Mapping Program And the Geodatabase

Executive Summary

A multipurpose Geographic Information System (GIS) digital database is being developed by the State of Tennessee. The Tennessee Base Mapping Program (TNBMP) was initiated by the Comptroller of the Treasury, Division of Property Assessments in 1996 with a two county pilot program whose goal was to define specifications for this effort and to test the concept of a digital, state-wide mapping program. Upon the completion of the pilot program, the Department of Finance and Administration, OIR-GIS Services assumed the role of project manager and funding was appropriated to begin statewide production in 2000. The original specifications used for the statewide production were the culmination of the Pilot Mapping Program and are based upon the ESRI coverage/librarian data model for all of the planimetric and parcel features.

With improvements in GIS data modeling techniques ESRI developed and released an object oriented data model known as the geodatabase. The purpose of this document is to provide the Tennessee GIS user community with a historical perspective of how the State developed a geodatabase model for TNBMP data, provide specific benefits for maintaining TNBMP data in the geodatabase environment, describe related technologies, and provide specific details on how local TNBMP partners can work with State staff to migrate coverage/librarian data to the geodatabase environment.

Table of Contents

# 1	The TNBMP and the Geodatabase: An Overview

Development History

Work began in 2003 to develop a geodatabase strategy to support the Tennessee Base Mapping Program. ESRI staff in conjunction with personnel from the Department of Finance and Administration and the Comptroller of the Treasury developed a work plan to accomplish three objectives:

1. Develop a Geodatabase Design
2. Develop an automated Data Migration Tool
3. Assist Local TNBMP partners with Geodatabase Migration

The geodatabase design process was developed to identify the appropriate model that would enable the State and local partners to efficiently manage and maintain the data products produced through the TNBMP. Through an iterative process, ESRI staff provided State personnel with multiple geodatabase models that were evaluated to maximize the benefits of the geodatabase environment. Several modifications were made throughout this process. The final geodatabase model (see Attachment A) was adopted by the State and work began on the data migration tool in late 2003.

The intent of the data migration tool is to streamline the migration of the coverage/librarian datasets to create either a personal geodatabase or an SDE geodatabase for State and/or local government. As was the case with the development of the geodatabase model, the migration tool was developed through an iterative process. ESRI staff developed the migration tool to account for all of the coverage features as well as the significant amount of annotation required to support the parcel mapping requirements of the county property assessor. Upon final delivery of the migration tool, additional modifications were made by Comptroller staff to optimize the migration process and to enable the migration tool to work in the ArcGIS 9.1 environment.

Future TNBMP Developments

The Comptroller of the Treasury, Office of Local Government GIS/Mapping section has custodial responsibilities for the TNBMP parcel data. This role includes supporting the county assessor in a number of capacities including: implementation support, performing annual review of the digital parcel data, education, and application development. Migration to the geodatabase is an additional service the DPA will provide to the county assessor's office (see Chapter 3 for more details).

The geodatabase migration of the TNBMP data maintained at the local level will facilitate the State's goal of creating and managing a comprehensive statewide parcel based GIS. Several agencies with State government have specific business requirements for accessing and analyzing parcel information. The future vision is once counties are migrated to the geodatabase environment, updated parcel geometry with an appropriate

subset of real property attributes will be inserted into a statewide SDE geodatabase for agency use.

2   Benefits of the Geodatabase and ArcGIS

Advantages of the Geodatabase over the Coverage/Librarian model

In the geodatabase model, spatial data is stored and managed by taking advantage of existing relational database management systems (RDBMS) and ESRI's Spatial Database Engine (SDE).

The geodatabase stores the feature data as seamless data layers. The traditional tiling or indexing structure is not required. The feature class data is managed as single entities by the RDBMS and doesn't have to be broken up into hundreds of pieces stored in separate files. Also, features that used to be maintained in multiple parts because they fell on tile/index boundaries no longer have to be split apart.

In the geodatabase, you can define default values, subtypes, population methods, and validation rules for attribute values. Working with ESRI, the State's geodatabase model incorporates many of these features, all of which allows for more efficient and accurate maintenance of the GIS data.

Also, new customizable set of topology rules for maintaining spatial relationships between features means you are no longer bound by the Librarian/coverage model topology rules. The advantage of these new topology rules allows can prevent data errors and eliminates the need for some of the conventional post processing quality control procedures, saving time and effort.

Enterprise Geodatabase potential

The potential for "enterprise" use of GIS data is significant. The data can be stored at a central, secure, location and accessed in various ways across the enterprise. This enterprise concept allows local governments to provide and manage multiple copies of the TNBMP GIS data for various users on separate machines spread out across many departments. The geodatabase can be accessed over a local network, on an intranet, and/or over the Internet. It can be used by the ArcGIS desktop applications, as part of a website service, and/or custom applications.

Keeping current with technology

ArcGIS, ESRI's suite of desktop (ArcInfo, ArcEditor, ArcView) and server software products (ArcIMS, ArcServer) is built using the Common Object Model (COM) and can be customized using any of the "standard" COM-compliant languages. Visual Basic, C++, .NET languages, etc.

The geodatabase engine (SDE) is built to take advantage of the major multi-user relational database management systems (RDBMS) like Oracle, MS SQL Server, and a few others.

ArcGIS and the geodatabase can also be used with the new "personal" and "mobile" devices like PDAs. Most of these have GIS applications available for them and wireless network functionality built-in.

Migrating to the geodatabase and the ArcGIS software environment will also provide users with the ability to access other spatial data formats, store and access various new types of digital imagery.

ESRI has made a commitment to the ArcGIS product suite. As a result, the software that edits and maintains Librarian and coverage data (Arc/Info Workstation) is not being enhanced and may eventually be unsupported by ESRI. For TNBMP partners, it is imperative to plan for geodatabase and ArcGIS migration to maximize the existing investment and commitment to GIS.

The following "Top 10 List" provides a more technical perspective on the advantages of the geodatabase and ArcGIS,

Geodatabase and ArcGIS: Top 10 List

1. Faster, more intuitive to use with an improved "Help" system and documentation.

2. It allows for less restrictive workflow management options.

3. It supports "heads-up" digitizing/mapping directly from orthos or other scanned sources.

4. Multiple users can edit features in the same geographic area without having to wait on each other as they check-in and check-out the needed tiles of data.

5. ArcGIS supports "on the fly" re-projection for viewing data from various sources in different formats.

6. Uses stable, secure, industry standard, relational databases to store data.

7. Supports feature labeling and feature-linked annotation.

8. The page layout option for designing and printing "ad hoc" maps.

9. "Disconnected Editing" allows mobile users to take the data to the field, make changes there, and then push the changes back into the geodatabase.

10. It contains over 100 built-in commands for common geoprocessing tasks.

Complete and Customizable Solution

All of the tools for creating, maintaining, viewing, and analyzing GIS data are provided "out-of-the-box", which means third party software solutions are optional.

Various software extensions are also available from ESRI and other vendors that plug directly in to ArcGIS for performing specialized functions. Several of these specialized extensions (ArcPress, ArcScan, Maplex for ArcGIS, and Streetmap) are now included as standard components for each license of ArcGIS.

All of the ArcGIS applications are built using COM and most of the tools can be customized. New tools can be built using standard development languages like VB, C++ and the .NET tools. There are a large number of resources and many developers that are now able to assist in customizing GIS if needed.

UML/XML: What are they?

Unified Modeling Language (UML) is a modeling language used for designing, developing, and documenting objects and their relationships as a system or part of a system. In GIS, the features or "objects" we model consist of the various points, lines, polygons, annotation, images, etc., and the system we are modeling is what is stored in the geodatabase.

Simply put, the TNBMP Geodatabase Design (see Appendix A) in its original format was delivered as a UML document that modeled all of the TNBMP geodatabase features.

For more info on UML see:
> http://www.uml.org
> http://www-306.ibm.com/software/rational/uml/
> http://support.esri.com/index.cfm?fa=knowledgebase.documentation.viewDoc&PID=43&MetaID=658

Extensible Markup Language (XML) is a cross-platform, extensible, software and hardware independent, text-based standard for representing data.

Since the release of ArcGIS 9.0, XML can be used to import and export all the items and data in a geodatabase, such as domains, rules, feature datasets, and topologies. With this change, XML has been adopted as the current delivery vehicle for the TNBMP Geodatabase Design Schema.

For more info on XML see:
> http://www.w3.org/XML/
> http://downloads.esri.com/support/whitepapers/ao_/XML_Schema.pdf

3   Geodatabase Deployment for TNBMP Partners

With the advent of geodatabase technology, the Comptroller of the Treasury, Office of Local Government GIS/Mapping section has expanded its role in the Tennessee Base Mapping Program to offer what has come to be called the Personal Geodatabase (PGDB) Solution. This PGDB solution is offered to local partners as a simple and low cost way to participate in geodatabase technology and Desktop ArcGIS editing. This solution is a limited implementation of the geodatabase and is designed exclusively for digital parcel maintenance in a single editor environment. At such time that a local partner brings greater resources to bear, the Personal GDB can be scaled upward or replaced entirely by more sophisticated technology. As deployed, however, the Personal GDB is sustainable in its original form and scope.

High Level Workflow
The benefits of the geodatabase over the file-based coverage data model are apparent. Nonetheless, there are other considerations that each TNBMP partner must weigh before choosing a geodatabase solution. The Comptroller's OLG GIS/Mapping section will assist and educate TNBMP partners by reviewing implementation options, performing geodatabase data migration, conducting on-site implementation, and providing continued support and monitoring.

Implementation Options: Enterprise vs. Personal
Choosing the best path to implement the geodatabase will vary among local partners. At this time, an assessor can choose either an Enterprise Geodatabase, or a Personal Geodatabase (PGDB).

The enterprise geodatabase option is appropriate for local partners that currently have two or more mappers editing the digital parcel data. It may require the procurement of additional hardware and software. Specifically, the enterprise geodatabase requires the use of ESRI's Spatial Database Engine (SDE) and a relational database (i.e. Oracle, SQL Server, etc.) to store and maintain the geodatabase. The enterprise option is also best suited for counties that may want to integrate other GIS data sources into a countywide GIS operation.

The personal geodatabase option is appropriate for local partners that only require the use of one mapper. This option is a lightweight option that does not require the use of ESRI's SDE product or a relational database. It is less expensive than the enterprise geodatabase option but is not suitable for developing a truly integrated GIS operation. The personal geodatabase option is scaleable, so when interest and resources in developing a true enterprise GIS are in place an assessor's office can migrate to the SDE geodatabase environment

There are three ways a partner can implement either the enterprise or personal geodatabase:
1. Contract with a vendor to provide the solution
      (Smart Data Strategies for example, has migrated its parcel maintenance
      product, Mapper, to support editing in a Geodatabase.)
2. Utilize the OLG/GIS Personal Geodatabase solution

3. Develop an internal solution and proceed independently.

Obviously, if a local partner chooses either a vendor or an independent process for the geodatabase, the OLG GIS/Mapping role is limited to a very few areas. In general, the local partner will need to work closely with the TNBMP Project Manager at OIR-GIS Services when vendors or an independent track are involved.

To recap, these are the TNBMP data migration options:
1. Enterprise GeoDataBase
    - Vendor
    - Independent

2. Personal GeoDataBase
    - Vendor
    - State - OLG GIS/Mapping section
    - Independent

Prospective TNBMP local partners are encouraged to seek as many sources of information regarding the geodatabase as time and resources permit. The Comptroller's OLG GIS/Mapping section is always ready to answer questions or direct local partners to other sources, including but not limited to, ESRI, SDS, and other local partners.

Geodatabase Migration

OLG GIS/Mapping staff will schedule specific times with county staff to migrate the coverage/librarian data to a Personal GeoDB or an SDE GeoDB. When converting to a Personal GeoDB, this process includes the following steps:
1. Identify a primary contact in the county
2. Evaluate migration potential to the Personal GeoDB and utilization of the State's associated maintenance solution
3. Upon confirmation of the Personal GeoDB migration, the Assessor staff submits a copy of their existing coverage/librarian data for review.
4. Appropriate preprocessing data corrections are applied to the coverage data.
5. Schedule appropriate GIS software training (this may require a trip to Nashville)
6. Perform data migration from the coverage model to the Personal GeoDB
7. Post processing evaluation and follow up with Assessor staff

Although the software maintenance solution is specific to the Personal GeoDB, the OLG GIS/Mapping section can migrate assessor parcel data to an SDE GeoDB. This will require coordination with a software vendor who will provide the software solution and related technologies (Oracle, SDE, etc.)

On-Site Implementation

Upon completion of the Personal GeoDB migration, OLG GIS/Mapping staff in conjunction with regional DPA staff will provide on site implementation assistance. Data will be installed and verification of software performance will be conducted. A checklist of post implementation activities will be reviewed with assessor staff. Additional on-site training will be provided based upon scheduling and other commitments. On-site implementation and post evaluation task should usually take 1-2 days, depending upon

location of the installation, experience of the assessor staff, and other technical limitations or delays.

Support and Monitoring

The Personal GeoDB solution includes a minimum level of support. The OLG GIS/Mapping section has developed a Memorandum of Understanding between the State and county assessors offices that identifies specific roles and responsibilities for maintaining Tennessee Base Mapping Program data. Specifically, the State will provide support to assessor staff using the Personal GeoDB solution through annual review of the geodatabase. If additional support is required OLG GIS/Mapping management will review individual requests on a case-by-case basis and respond accordingly. The State is committed to ensuring the successful maintenance of the parcel data through the Personal GeoDB solution. Technical assistance for ArcGIS users is also provided through ESRI via telephone support. ESRI support is included with annual maintenance costs with the ArcGIS product line.

As county assessor GIS mapping staff gain experience and knowledge, the foundation of regional user groups can be an additional source of support and sharing of knowledge. The OLG GIS/Mapping section will continue to facilitate education and training opportunities through these regional meetings.